

[0015] In one embodiment, an apparatus for adjustably changing biaxial strain on a thin film according to the invention comprises a ring of shape memory alloy that has a first inner perimeter. The ring is reversibly reshaped, resized or otherwise changed in configuration so that it has a second inner perimeter, wherein such reversal to said first inner perimeter is a function of temperature and the shape memory characteristics of the ring. The apparatus includes means for securing a thin film on the ring such that, when the ring adjusts between the second and the first inner perimeter in response to a change in temperature applied to the ring, the biaxial strain on the thin film in turn changes in response to a change between the second and the first inner perimeter of the ring.

[0016] Another aspect of the invention is a device where the shape memory alloy comprises Nickel Titanium.

[0017] A further aspect of the invention is a means for securing a thin film. In one embodiment, the ring has a top portion and a bottom portion, the top portion has a first continuous groove, the bottom portion has a second continuous groove, and the first continuous groove is adapted to align with the second continuous groove. A means for coupling the top portion and the bottom portion of the ring is provided such that the thin film fits securely between the first continuous groove and the second continuous groove when the top portion and the bottom portion are coupled.

[0018] In one embodiment, the first continuous groove in the top portion is configured in a first shape, the second continuous groove in the bottom portion is configured in the first shape, and where the first shape is selected from the group consisting essentially of a circle, an oval and a polygon.

[0019] In one embodiment, a plurality of gaskets are adapted to couple to the thin film, where the gaskets are further adapted to fit in the first and second groove, grip the thin film, and the gaskets are configured to change biaxial strain on the thin film in response to a change between the second perimeter and the first perimeter of the ring.

[0020] A further aspect of the invention is a means for coupling the top and bottom portions of the ring where in one embodiment the ring has a circular ridge in the top portion of the ring where the circular ridge in the top portion of the ring has male threads, and the ring has a circular recess in the bottom portion of the ring where the circular recess in the bottom portion of the ring has female threads, wherein the male threads on the top portion are adapted to mate with the female threads on the bottom portion, and wherein the top portion of the ring is coupled to the bottom portion of the ring when the male threads are securely engaged with the female threads.

[0021] A still further embodiment of the invention has a first continuous recess in the top portion of the ring, and a second continuous recess in the bottom portion of the ring where the first continuous recess of the top portion is adapted to mate with the second continuous recess of the bottom portion of the ring. A counter ring is adapted to align with the first continuous recess in the top portion and the second continuous recess in the bottom portion where the counter ring is further adapted to fit securely between the first and second continuous recesses when the top and bottom portions are coupled. The counter ring is made of

shape memory alloy, has a first outer perimeter or shape and has a reversibly changed second outer perimeter or shape where the counter ring reversibly changes from the first outer perimeter to the second outer perimeter in response to changing the temperature of the ring. The ring reversibly changes from the first inner perimeter to the second inner perimeter when the counter ring adjusts between the second and the first outer perimeter in response to changing the temperature of the counter ring.

[0022] In one embodiment, the first continuous recess in the top portion is configured in a first shape, the second continuous recess in the bottom portion is configured in the first shape, and the first outer perimeter of the counter ring is configured in the first shape, and where the first shape is selected from the group consisting essentially of a circle, an oval and a polygon.

[0023] In a further embodiment of the invention, the counter ring is electrically isolated from the ring, temperature of the ring is changed by applying electric current to the ring, and in the temperature of the counter ring is changed by applying electric current to the counter ring.

[0024] A still further aspect of the invention is where the ring is configured to be a prime mover of a reversible radial actuator.

[0025] According to another aspect of the invention, in one embodiment the ring has a top surface and a bottom surface, the second inner perimeter of the ring is adapted to hold a removable wax disc, the removable wax disc has at least a top surface, the removable wax disc is temporarily positioned in the second inner perimeter of the ring, and the thin film is deposited on the top surface of the ring and on the top surface of the removable wax disc.

[0026] In a further embodiment, a counter ring is adapted to align with the ring, the counter ring is further adapted to couple to the ring, the counter ring is made of shape memory alloy, the counter ring has a first outer perimeter, the counter ring has a reversibly changed second outer perimeter, the counter ring reversibly changes from the first outer perimeter to the second outer perimeter when the ring changes between the second and the first inner perimeter in response to changing temperature of the ring, and the ring reversibly changes from the first inner perimeter to the second inner perimeter when the counter ring changes between the second and the first outer perimeter in response to changing the temperature of the counter ring.

[0027] A further aspect of the invention is where the device is adapted to be positioned in a specimen holder of a transmission electron microscope.

[0028] A still further aspect of the invention is where the thin film is supported on a substrate, and the substrate coupled to the ring.

[0029] Another aspect of the invention is where the first inner perimeter of the ring is up to about five percent larger than the second inner perimeter of the ring.

[0030] A further aspect of the invention is where the ring is adapted to be reversibly changed from the first inner perimeter to the second inner perimeter at about room temperature.

[0031] A still further aspect of the invention is where the top surface of the ring and the top surface of the removable wax disc are polished, and the thin film is a metal.